THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 24. Thursday, September 8th, 1921. No. 264.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

**The Foundry Trade Journal,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C.2.**

Contents.

	PAGE
Notes and Comments	185
Correspondence	186
Aluminium Pistons for Petrol Engines	187
Notes on Centrifugally Cast Steel	187
International Foundry Trades Exhibition	187
Laboratory Furnace for Deformation Temperature of Refractories	188
The Metallurgical Possibilities of the Belgian Congo	188
The Chilian State Railways	188
Sulphur in Malleable Cast Iron	189
The Foundries of Messrs. Hamilton & Sons, Limited, Cardiff	190
Growth of Length Gauges	191
Foundry Reorganisation.—Part II.	192
An Appreciated Gift	193
Foundry Trade Exhibition, Munich, 1921	193
Brazilian International Exhibition, 1922	193
Gear Patterns	194
Materials Used in Aeroplane Construction	196
Trade Talk	197
Iron and Steel Markets	199
Gazette	200
Deaths	200

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, Bessemer House, Adelphi, Strand, London, W.C.2.
Manchester: J. Hogg, 365, Manchester Road, Burnley, Lancs.
Birmingham: F. B. Holberry, 22, Salisbury Road, West Bromwich.
Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.
Scottish: W. H. Bound, 16, Grantley Gardens, Shawlands, Glasgow.
Peterborough: H. P. Mason, Prudential Chambers.
London: V. C. Faulkner, 21, Stanley Gardens, W.11.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: F. H. N. Lane, Queensbury, 2, Dover Street.
Welsh Engineers' and Founders' Association: Secretary, E. J. Griffiths, 20, Fisher Street, Cardiff.

NOTES AND COMMENTS.

The Suitability of Processes.

From time to time an enthusiast comes along with some new process which he promises will revolutionise the iron or steel trade, or a large section of the one or the other. As times goes along, it is found that the process confines itself to the section of the trade to which it is peculiarly adapted.

The oldest method of making liquid steel is by the crucible process, and times innumerable has the process been threatened with extinction, but, even taking into consideration the slack trade conditions, it is probably of larger dimensions than when its first competitor came into the field. Some ten years ago it was threatened by the electric furnace. If the order book of a Sheffield crucible steel works were examined it would be seen to be composed of quite large tonnage orders associated with numerous requests for a few bars of many brands of steel. These brands of steel have been developed over a long period by experiments conducted for each individual customer. These brands are extremely numerous, and as speciality firms only require small quantities at a time, they cannot all be made into large quantities and stocked. The smallest size of commercial electric furnace has a capacity of 10 cwts., and this is found to be too large for many brands of steel. Owing to the electric furnace having, during the war, outgrown the necessary skilled staff required for their operation, and to over-production, it was predicted by some that they had "had their day," and were rapidly becoming a "back number." Some of the conditions favourable for their employment, such as the availability of large quantities of shell turnings, ceased to exist. Some firms set about reducing their costs by the adoption of duplex and triplex processes, and were able to continue. However, the boom being over, the industry settled down to its true sphere, that is the production of high-grade steel castings, stainless steel, and medium-sized orders, which were found to be too small for the open-hearth and too large for the crucible. An order for special steel which can be made in one cast from any furnace often proves expensive, for should just one element be away from the specification it involves the making of another cast. If, however, an order which can be divided over ten casts is received, even though the first one is useless, it probably gives sufficient information to ensure the others coming out correctly, and a profit can be shown on the order.

We can easily imagine the time when superiority of loam dry and green sand would be equally strenuously debated, but to-day it is recognised that each has its own sphere, with the obvious encroachment at the border lines.

The electric furnace has only just made its appearance in the British foundry, and preconceived notions are beginning to show themselves. On the one side there will be the prophets who would have us scrap all cupolas on account of the sulphur problem, and on the other, the "doubting Thomases," who will cover their ignorance by asserting that electrically manufactured iron has a "dry" fracture, and it may show excellent mechanical properties, but it lacks "body"; and again, owing to the high temperature of the electric arc, it must have the "nature" burnt out of it. In between these optimists and pessimists there will appear some reasonable foundrymen, who will readily recognise that whilst it is totally unnecessary for the manufacture of sash-weights, it will find its sphere of usefulness in the making of the highest grade of grey iron castings and for some types of malleables. Whilst the cost of working the various processes is of great importance, the technical aspect may be paramount, the conditions being the production of a greatly superior and an entirely new product. In such a case comparative costs as regards other processes can be neglected, as an entirely new market is created.

Institution of British Foundrymen—Conference at Blackpool.

Railway Arrangements.—Members who desire to travel to Blackpool by the Lancashire and Yorkshire Railway on the Friday or Saturday before the conference will require to make application to their "home" station a few days beforehand for special tickets authorising them to travel by specified trains. There is no restriction on any other days. Members travelling by the L. & N.W. Railway viâ Crewe or Wigan, or from stations north of Preston on the Friday or Saturday, September 16-17, will be booked through on application.

Return Journey.—Members returning by L. & Y. or L. & N.W. trains from Blackpool or stations to Lytham on Saturday, September 17, or Monday, September 19, will require special tickets, which will be issued in advance, authorising them to travel by a specified train.

Friday, September 16.—Special tramcars conveying the party to Fleetwood will leave Talbot Road Station at 9.15 a.m.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Silicon in Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The excellent articles on cast iron by Professor Rhead, which have appeared in your Journal, should be closely followed by every foundryman. I would like, however, to point out an error in the statement that silicon may exist in cast iron as the silicide FeSi, and in the Table I., wherein the silicon is assumed as present as the mono-silicide FeSi (page 379, April 28, 1921).

It has been proved by Wüst and Petersen that when silicon is added to eutectic metal of the composition 4.3 per cent. C. 95.7 per cent. iron, the carbon content is progressively lowered with increasing silicon additions, the alloys being mixtures of the 4.3 per cent. C. eutectic and iron silicide.

It is evident that iron carbide Fe_3C is displaced by the silicide of iron. If the latter is of the composition Fe_2Si, then if the carbon of the carbide is liberated it will be seen that each per cent. of

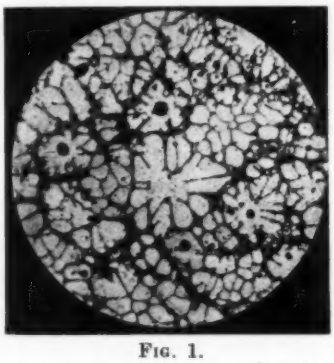


FIG. 1.

Si liberates 0.286 per cent. of carbon, the reaction being:—

$$2Fe_3C + 3\,Si = 3\,Fe_2Si + 2\,C$$
$$360 \quad 84 \quad 420 \quad 24$$
$$1.0 \quad 0{,}286$$

Similarly, if the silicide has the composition FeSi, then the liberation of carbon will be 0.143 per cent. for each per cent. of silicon, half that in the former case. The reaction would be:—

$$Fe_3C + 3\,Si = 3\,Fe\,Si + C$$
$$180 \quad 84 \quad 252 \quad 12$$
$$1.0 \quad 0.143$$

The results of Wüst and Petersen are shown in the table below, in which I have added columns showing the calculated carbon contents on the two hypotheses that silicon is present as Fe_2Si or FeSi. It will be seen that the actual results obtained by Wüst prove that the silicide present is Fe_2Si.

TABLE I.

Si contents per cent.	Wüst.	Carbon contents— Estimated as Fe_2Si.	Carbon contents— Estimated as Fe Si.
Per cent.	Per cent.	Per cent.	Per cent.
0.13	4.29	4.26	4.28
0.21	4.23	4.24	4.27
0.41	4.11	4.18	4.24
0.66	4.05	4.11	4.20
1.14	3.96	3.97	4.13
1.41	3.88	3.82	4.09
2.07	3.79	3.71	4.00
2.68	3.56	3.53	3.91
3.25	3.41	3.38	3.83
3.69	3.32	3.24	3.77
3.96	3.24	3.16	3.73
4.86	3.08	2.91	3.60
5.06	2.86	2.85	3.57

I would further state that a similar research was conducted by myself some years ago (before Wüst's experiments were made) with the same results. I found that the characteristic structure of alloys of Si and Fe, melted under carbon and quenched from the molten, was a ground mass of 4.3 per cent. C. eutectic containing dendrites of Fe_2Si. The 20 per cent. Si alloy was practically carbon-free, and was, when quenched from the molten, a mass of uniform polygonal thin boundaried crystals of yellow hue when etched with 2 per cent. nitric acid reagent. The micro-photographs 1 and 2 (167 diam.) represent the structures of the 15 per cent. silicon alloy containing about 0.4 per cent. carbon. Fig. 1 shows the alloy as quenched from the molten, and Fig. 2 the same when slowly cooled. In the latter the solubility of the silicide in the iron mass is clearly defined.

The results indicated in the table are of great interest to foundrymen, giving as they do a clue to the function of silicon as silicide in liberating carbon in cast iron.

In my research I found that the freezing points of the alloys containing 0.10 to 5 per cent. silicon rises from 1,140 deg. to 1,215 deg. C. Also that when fusing the alloys under carbon, if the temperature exceeded the melting point, the greater the superheating the more readily did the alloys absorb further carbon, which was precipitated as coarse graphite on slow cooling. This phenomenon is most pronounced in the alloys containing between 4 and 10 per cent. silicon.

Another point of interest is that the ratio between the silicon and carbon contents diminishes

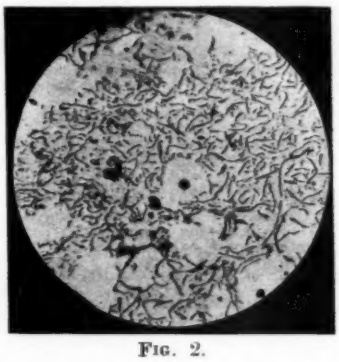


FIG. 2.

regularly as the silicon increases, until about 4 per cent. silicon is reached, after which the ratio diminishes much more slowly up to 15 per cent. when the carbon should theoretically be zero. The 4 per cent. silicon change point is observable in pig irons, beyond which point "glazed-pig" characteristics are the rule.—Yours, etc.,

I. E. FLETCHER,
Director of Research
(*pro tem.*).

The British Cast-Iron Research Association,
Central House, New Street, Birmingham.

August 26, 1921.

Scientific Foundry Methods.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In an article appearing in your last issue advocating the use of a "medicine" to cure one of the many ills that foundrymen are heirs to, it was stated that "it pays to adopt scientific methods."

All modern foundrymen will cordially agree with the latter statement. Unfortunately, however, there is much loose thinking and expression as to what is meant by "scientific methods." No industry demands the application of scientific methods more than the foundry business, but the individuals responsible for the operation of our foundries must possess the scientific mind if they would adopt such methods. They must be able to investigate problems intelligently and arrive at sound judgments, which preconceived ideas and prejudices will not distort.

Every difficulty has a cause, and the foundryman who investigates each case thoroughly will be always on firmer ground than he who flies to a "medicine" to overcome the trouble, and of the two the former is the scientific man.

This statement does not imply that the scientific foundryman will not use "medicines," but that he will demand to know what the medicine is, and thus will his knowledge be widened.

In these days all the materials used by the foundryman have to bear the test of chemical and physical investigation. It is, therefore, rather

late in our development to offer remedies and attempt to keep their composition secret.

The foundryman will welcome any new aid which will increase the efficiency of his practice, and, whilst the results of their use may be gratifying, he will not be scientific until he has understood as far as possible cause as well as effect.

Our friends who have remedies to offer will, therefore, appreciate the development of scientific methods when they are prepared to state the composition of their goods instead of attempting to hide their indentity under a catchy name. Otherwise they lay themselves open to the charge of exploiting the difficulties of the foundryman for commercial advantage.—Yours, etc.,

H. SHERBURN.

Warrington,
September 3, 1921.

Aluminium Pistons for Petrol Engines.

Data on some experiments on aluminium pistons for petrol engines have been published by W. Von Selve in the *Zeitschrift des Vereines deutscher Ingenieure* for June 12, 1920.

These tests show the advantages of aluminium as compared with cast iron for pistons, owing to their lower specific gravity, better thermal conductivity, better frictional conditions, and their insensitiveness to the effects of air, water, oil, and acids. The comparison extends to aircraft engine pistons made by different processes, the piston diameter in each case being 140 mm. (6 ins.).

	Cast Iron	Aluminium sand-cast	Pressed Aluminium.	Aluminium chill-cast.
Weight of unmachined piston in lbs. ..	13–15	6.6–7.9	17.5	6.5
Weight of foundry discard, kg.	6.5	2.2	3.3	1.65
Faulty castings per cwt.	10	20	20	5.10
Total metal required, kg	11	11	22	8.8
Weight of turnings in machinery, kg. ..	..	1.65	13.2	1.65
Strength of finished piston, per sq. in. ..	11.5–12	11.5–12.7	21–22.8	12.7–15.8
Strength after 10 hours running, tons, per sq. in.	11.5	1.5–10.7	16.5–19.6	11.5–12
Elongation at rupture per cwt.	..	1	1.5	1-1.5
Ratio of approximate price of machined pistons	1	3	6.5	2

The comparison shows that chill-cast aluminium pistons, which satisfy all requirements, are economically the most advantageous, as the increasing demand for them demonstrates.

Notes on Centrifugally Cast Steel.

BY GEORGE K. BURGESS.

The production of metal castings by the centrifugal process for certain non-ferrous metals and cast-iron shapes may be said to have passed beyond the experimental stage. In the case of steel very little appears to have been published regarding the properties of the metal thus cast.

Opportunity was given to the Bureau of Standards to examine in detail the physical and chemical characteristics of six centrifugal castings made by the Millspaugh process. The results are interesting in showing what may be expected from such metal as compared with the product of the more familiar manufacturing processes. The advantages to be expected from centrifugally-cast steel are physical soundness and freedom from chemical segregation and thus the elimination of waste metal to be discarded, which last is always a very important factor in other processes of manufacture. For certain shapes forging and boring operations may be eliminated. The investigation shows that highly satisfactory castings which are physically sound and free from serious segregation may be produced by the centrifugal method. It is shown that the properties of these castings can be improved greatly by subsequent heat treatment such that the metal may be put in a condition to compare favourably with metal that has been forged.

International Foundry Trades Exhibition.

The occasion of the Institution of British Foundrymen's Conference in Birmingham in 1922 has been fixed upon as the opportune moment to present a comprehensive display of all equipment appertaining to foundry practice, and with this in view, a happy combination of the British Cast-Iron Research Association and the Institution of British Foundrymen, representing the technical aspect, and the Birmingham Chamber of Commerce undertaking the business organisation has resulted in the formation of a capable directorate to see the matter through.

The exhibition will be the first enterprise of the kind to be promoted in this country. United States, France and Belgium will be represented among the exhibits, as well as British founders. Both the raw materials and the finished products of the foundry will be represented, aluminium castings being included, as well as iron. There will also be a display of plant, including a completely equipped model foundry, to which a large number of firms have promised to contribute.

A General Council has been elected, representing all aspects of foundry work, together with the Council of the Birmingham Chamber of Commerce. The members of the Committees are all prominent in trade and business circles, and it need only be recalled that the staff who are responsible for the British Industries Fair, Birmingham, are entrusted with the carrying through of the arrangements for the Exhibition, with Mr. G. Henry Wright and Mr. T. Vickers as Secretaries and Mr. Charles Stanley as General Manager.

The exhibition will be held in the Bingley Hall, which is situated within a few minutes' walk of the Town Hall, Post Office, railway and tram termini, and is very spacious and well lighted, with ample accommodation for the comfort and convenience of exhibitors and visitors, and has every facility for the utilisation of power for exhibiting machinery.

It is anticipated that there will be a large demand for space, and to ensure that an allotment is secured, intending exhibitors are urged to make early application to the Birmingham Chamber of Commerce (Incorporated), New Street, Birmingham, stating the amount of floor space required.

An official catalogue will be published and suitable advertisements will be inserted.

The Exhibition being for business only, special attractions will be provided in the shape of lectures by experts on subjects coming under the headings which comprise the objects of the undertaking. A prominent feature will be a special series of films demonstrating processes of organisation, equipment and manufacture, and it is hoped that intending exhibitors whose methods may be beneficially thus displayed will avail themselves of this opportunity.

The exhibition will cover a wide range of apparatus and materials, including:—General foundry plant: foundry requisites; pattern making; moulding sands; laboratory equipment; refractories.

Combined Exhibits by Trade Groups, including:—Grey foundry work; malleable foundry work; semi-steel; cast-iron rolls; non-ferrous foundry; steel castings.

Raw Materials. — Pig-iron, alloys, scrap, coke, etc.

Finished Goods.—General castings, die-castings, ferrous and non-ferrous (including hollow-ware). light castings, pipes, stoves, etc.

Technical educational institutions, associations and publications; trade press publications; competitions in core-making, moulding, pattern-making, etc.; historical and statistical exhibits (honorary); foundry office and works organisation requisites; technical lectures and papers.

American Steel Workers' Wages.—A cable from New York states that in view of the low selling price prevailing for steel, the United States Steel Corporation announces another reduction in wages for day labour from 37 cents to 30 cents (1s. 3d. at par) an hour.

XUM

Laboratory Furnace for Deformation Temperature of Refractories.*

BY LEON R. OFFICE.

For a good many years laboratories that have been testing high-grade refractories, as fireclay, fireclay and silica bricks, silica cements, etc., have been confronted with the problem of a suitable type of furnace.

The author has in mind such a furnace for which he claims no originality of principle, but which was developed through four years of experience in obtaining the softening and deformation temperatures of various refractories. Innovations were tried, such as: Different sized chambers, various types of burners, length of burner, thickness of walls, insulation features, etc., and the

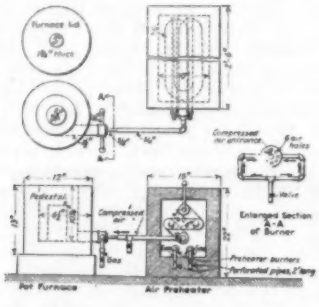


FIG. 1.—DETAILS OF FURNACE CONSTRUCTION.

type to be described seemed to work advantageously. It is not so difficult to deform pyrometric cone 32 (approx. 1,705 deg. C.), but to reach cones 34 and 35 is more troublesome.

In the "Transactions of the Am. Ceramic Society," Vol. 16, p. 386, C. E. Fulton described a pot furnace of the "open flame" type, with one burner which gives the flame a spiral motion. This furnace was used in the author's laboratories for several years, and was the basis of the type used at present.

The furnace, details of which are shown in Fig. 1, consists of two parts, the furnace proper and the preheater.

The furnace proper consists of a pot 12 in. wide and 13 in. high, with a chamber 6¼ in. in width and 10¼ in. in depth. It was found that a deep and narrow chamber produced the best results, since it has a "stack-effect" of drawing the gases and flame upward with a swirling motion. None of the gas would burn in the centre. The pedestal could be varied in height, just so it was above the gas inlet. The "pot" containing the cones is placed on top of the pedestal. The top is one

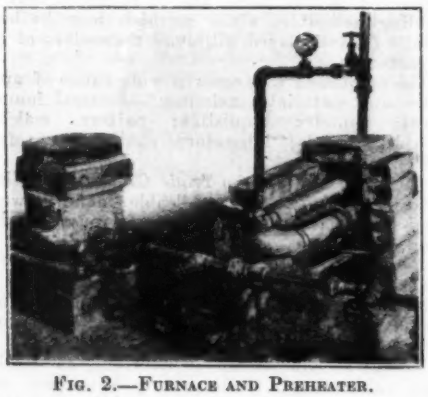


FIG. 2.—FURNACE AND PREHEATER.

piece, 1¾ in. thick, with a 2-in. inspection hole in the centre. If banded with a heavy iron band its life will be increased several hundred per cent. The furnace must also have an iron band which can be slipped over and bolted on one side.

A high-grade fireclay or a mixture of calcined bauxite and plastic fireclay can be used in making the furnace. The better the material the longer and more satisfactory will be its life.

The preheater consists of four lengths of 2-in. iron pipe, connected at the ends with U's and spaced so that the flame from the gas burners below will surround them. The air was not sent through the preheater until the furnace had attained a good red heat, as it increases the temperature too rapidly. Just as soon as air was sent through the preheater into the furnace, the temperature could not be regulated until almost a white heat was reached. With the preheater used, the air reached a temperature of 121 deg. C. at the burner.

Several types of burners on the market were tried, but proved less satisfactory than the home-made one shown in Fig. 1. The nozzle was 1¼-in. heavy iron pipe, 6 in. long, connected to a reducing cross which acted as the mixer. Gas entered the mixer through ¾-in. pipes on two sides. A reducing bushing was placed in the rear end of the mixer, with six ¼-in. holes, equally spaced. The air entered through a ⅜-in. pipe, the opening of which extended just beyond the gas inlets, in order to prevent back pressure on the gas. The air, coming in at high pressure, tended to suck the gas with it and also excess outside air through the six holes in the back of the mixer. With air at 25 to 30 lb. pressure and natural gas in the Pittsburgh district under a pressure of about 2½ lb., a temperature sufficient to melt cone 35 in forty-five minutes was attained. Fig. 2 shows the appearance of the apparatus.

This furnace, when made of a good refractory material, is very sturdy and can be used for fifty to sixty runs. Cracks can be instantly patched with Norton's alundum cement, and, after several heats, a glaze develops on the inside surface which protects the pot from further attack by the flame.

* Extracted from "Chemical and Metallurgical Engineering," Vol. 25, No. 4.

The Metallurgical Possibilities of the Belgian Congo.

A meeting of the supporters of the Syndicat d'Etudes de Gisements et Métallurgie au Congo was recently held at Brussels to receive a report from the mission sent to Katanga for the purpose of studying the situation with reference to the available iron ore and water power, with the idea of constructing electric reduction furnaces. The water-falls in question are at Lubudi, and they are said to be capable of developing 16,000 h.p. at dry periods and 120,000 during the rainy season. Considerable quantities of rich iron ore are available in close proximity to the falls, and analyse out at 54 to 58 per cent. of metallic iron.

The Chilian State Railways.

The Chilian State Railways have invited tenders for the supply of the following material:—Pumps, machine tools, etc., small tools and general hardware, chains, cables, ropes, etc., at an estimated cost of £26,250. Tenders will be received by the Departmento de Materiales y Almacenes, Ferrocarriles del Estado, Santiago, Chile, up to 10 a.m. on October 6 next. A copy of the specification (in Spanish) may be inspected by United Kingdom manufacturers and exporters on application to the Enquiry Room, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1; a copy is also available for loan to firms established in the provinces. The representatives of the Chilian State Railways in Paris, whose address is 88, Boulevard St. Michel, has been instructed by the State Railways to obtain prices in the United Kingdom and remit same by cable on the day previous to the opening of the tenders.

BRONZE FOR GONGS.—A recent issue of "La Fonderie Moderne" prescribes the following mixture as being suitable for bells and gongs:—Copper, 80; tin, 20 per cent. The copper should be melted under a thick covering of charcoal. As soon as the copper commences to melt a flux is added, composed of 4 parts of yellow prussiate of soda, 4 parts silica sand, 4 parts soda ash, and 4 parts borax. When the copper is completely melted the tin should be added whilst continually stirring.

Sulphur in Malleable Cast Iron.

By LEFTER C. CROME.

It is generally known that the evolution method for the determination of sulphur in such materials as white cast-irons is not at all reliable. It is also true that the oxidation methods require too much time for advantageous use in a control laboratory. Being confronted with the problem of obtaining a rapid and accurate analysis of white cast-irons, a thorough investigation of the problem was made, revealing some very interesting facts and also disproving some popular ideas concerning the determination of sulphur in white irons by the evolution method.

Complete chemical analysis with duplicate determinations of carbon, evolution sulphur and oxidation sulphur were obtained on forty samples of white iron, with the idea that they might reveal some relation existing between the evolution and oxidation values and some third quantity such as the percentage of combined carbon or the carbon : silicon ratio. The results of this investigation listed in Table I. showed no such relation—in fact, proved the contrary.

TABLE I.—*Chemical Analyses of the White Cast-Irons*

No.	C*	Si	P	Mn	Sulphur* Evolution	Sulphur * Oxidation
1	2.75	0.94	0.173	0.29	0.050	0.050
2	2.63	1.05	0.167	0.31	0.050	0.051
3	2.95	0.58	0.068	0.03	0.066	0.070
4	2.77	1.08	0.171	0.31	0.041	0.051
5	2.72	1.03	0.168	0.30	0.043	0.047
6	2.78	0.73	0.078	0.05	0.058	0.101
7	2.47	0.93	0.169	0.28	0.043	0.084
8	2.64	0.94	0.172	0.27	0.040	0.083
9	2.98	0.71	0.080	0.06	0.058	0.102
10	2.53	0.75	0.168	0.20	0.037	0.037
11	2.74	0.93	0.167	0.28	0.042	0.045
12	2.87	0.89	0.076	0.05	0·060	0.062
13	2.55	1.07	0.165	0.29	0.040	0.071
14	2.57	0.85	0.172	0.23	0.041	0.076
15	3.01	0.78	0.075	0.06	0.056	0.088
16	2.59	0.88	0.170	0.28	0.052	0.081
17	2.70	0.94	0.161	0.30	0.043	0.070
18	2.77	0.82	0.173	0.30	0.041	0.074
19	2.81	0.87	0.167	0.25	0.053	0.073
20	2.76	0.94	0.168	0.29	0.047	0.077
21	2.73	0.92	0.171	0.29	0.047	0.083
22	2.68	0.81	0.155	0.25	0.050	0.052
23	2.77	0.94	0.169	0.33	0.049	0.058
24	2.51	0.87	0.170	0.29	0.048	0.055
25	2.71	0.94	0.169	0.28	0.051	0.053
26	1.34	1.52	0.183	0.15	0.096	0.106
27	2.12	1.32	0.181	0.34	0.066	0.119
28	2.55	0.75	0.171	0.23	0.046	0.097
29	2.61	0.93	0.159	0.28	0.050	0.103
30	2.50	0.82	0.176	0.28	0.051	0.110
31	2.51	1.08	0.166	0.23	0.047	0.099
32	2.28	0.78	0.178	0.26	0.080	0.130
33	2.44	1.02	0.172	0.18	0.049	0.100
34	2.44	0.97	0.172	0.18	0.047	0.094
35	2.46	0.96	0.171	0.18	0.047	0.095
36	2.40	0.96	0.171	0.17	0.047	0.095
37	2.92	1.82	0.138	0.79	0.044	0.086
38	2.43	1.01	0.171	0.18	0.045	0.098
39	2.62	1.06	0.160	0.28	0.056	0.103
40	2.44	1.00	0.194	0.25	0.046	0.047

* The carbon and sulphur values were all checked by duplicate determinations.

These results classified the samples into three groups, as follows:—

(1) In about 25 per cent. of the samples (Nos. 1, 2, 3, 5, 10, 11, 12, 22, 25, 40) the evolution and oxidation values checked.

(2) In another group (Nos. 7, 8, 14, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38) the evolution method gave only about one-half or less of the total sulphur.

(3) The remaining samples gave varying values falling in between these two.

Samples with nearly identical complete analyses could be found in each of the three groups.

Samples giving only a small part of their sulphur by the evolution method were studied more thoroughly to determine what became of the missing sulphur. Accordingly several of them were picked and 10-gr. samples treated with hydrochloric acid exactly as in the ordinary evolution method. After the samples had dissolved, their solutions were filtered. The filtrates were oxidised with bromine, evaporated with nitric acid after the addition of sodium carbonate, and examined for sulphur according to the regular oxidation procedure. The results of this experiment showed that the solutions contained no sulphur whatever. The residues were carefully dried at 100 deg. C. and tested for sulphur by using both the nitric acid solution method, that of the U.S. Bureau of Standards, and by fusing with a potassium nitrate and sodium carbonate mixture. These results showed that only traces of sulphur remained in the residues.

From the results of these experiments, listed in Table II., it was evident that the sulphur not obtained by the evolution method must be evolved as some sort of a gaseous compound which is not absorbed by the ordinary media.

TABLE II.—*Examination for Missing Sulphur.*

No.	Sulphur by Evolution	Sulphur by Oxidation	Sulphur in Residue	Sulphur in Filtrate
35	0.047	0.096	0.006	Nil
7	0.043	0.084	0.007	Nil
8	0.040	0.083	0.007	Nil

Sulphur Lost on Annealing.

There is a popular idea that by annealing a cast iron it will give its total sulphur by the evolution method, even though it did not do so before. Accordingly two test-bars of the class where only half of the sulphur was evolved were placed in an electric muffle at 982 deg. C. and allowed to cool very slowly with the furnace. Then the sulphur was determined on these samples by both the evolution and oxidation methods. The results of both methods checked very closely, but instead of agreeing with the original oxidation value, they checked that of the evolution value before annealing. An amount of sulphur equal to the difference between the two had been lost.

Then five typical samples were selected from each group, and bars from these heats that had been through the annealing process in the regular annealing ovens (carbon completely graphitized) were obtained and their sulphur was determined by both the evolution and oxidation methods. These results, in Table III., substantiate those of the preliminary experiment, showing that the sulphur not obtained by the evolution method in the white iron was lost in the annealing process. In all cases the sulphur values of both methods

TABLE III.—*Sulphur Values on Regular Annealed Samples.*

No.	Sulphur before Annealing. Evolution	Sulphur before Annealing. Oxidation	Sulphur after Annealing. Evolution	Sulphur after Annealing. Oxidation
1	0.050	0.056	0.056	0.052
2	0.050	0.051	0.060	0.056
10	0.037	0.037	0.052	0.056
12	0.060	0.062	0.066	0.069
22	0.050	0.052	0.060	0.065
7	0.043	0.084	0.055	0.051
8	0.040	0.083	0.052	0.048
29	0.050	0.103	0.061	0.058
30	0.051	0.110	0.058	0.054
31	0.047	0.099	0.061	0.059
14	0.041	0.076	0.052	0.049
16	0.052	0.081	0.064	0.062
17	0.043	0.070	0.054	0.053
19	0.053	0.073	0.063	0.060
20	0.047	0.077	0.064	0.060

checked on the annealed samples, but in some cases they were slightly higher than the original evolution value, due to the small amount of sulphur which is usually taken up in the annealing oven.

These results show that in cases where the total sulphur in the white iron is not obtained by the evolution method it must be present in two distinct forms. That which is obtained is doubtless in the form of manganese and ferrous sulphides, and the remainder must be in some other form, but just what it might be the results obtained thus far do not show.

There is one point practically certain, however: No matter in what form this sulphur does exist, it does not have the same deleterious effects on the iron as the ordinary sulphur as sulphides. This, however, is only as might be expected from the fact that this amount of sulphur is subsequently lost in the annealing process.

In view of this fact, it is possible to determine the sulphur in white cast-irons by the evolution process, for even though it does not give the total sulphur in all cases, it always gives that which is injurious, and that is all that is desired to know in the control laboratory routine.—Chemical and Metallurgical Engineering. Vol. 25, No. 6.

C

The Foundries of Messrs. Hamilton & Sons, Limited, Cardiff.

The Victoria Foundry, East Moors, Cardiff, is the first Welsh firm to adopt the electric furnace for the manufacture of steel castings.

FIG. 1.—GENERAL VIEW OF THE FOUNDRY, MESSRS. A. HAMILTON & SONS, LIMITED.

FIG. 2.—TAPPING ELECTRIC FURNACE, MESSRS. A. HAMILTON & SONS, LIMITED.

As founders, they have a very complete installation, which embraces, in addition to the steel plant, iron and brass foundries.

As will be seen from the illustrations the buildings are of brickwork. They are divided into three main shops. The steel foundry, which is 150 ft. long by 50 ft. wide, is spanned by a 5-ton electric overhead travelling crane, supplied by Messrs. Herbert Morris, Limited, of Loughborough. The melting unit is a Greaves Etchell electric furnace, furnished by Messrs. T. H. Watson, of Lancaster Street, Sheffield. The normal rating of the furnace is 10 cwts., but, as is the case with most electric furnaces, it can be overloaded by some 50 per cent. It is equipped with static transformers of 260 k.v.a. capacity, supplied from the mains of the Cardiff Corporation. The working of the furnace is controlled from a modern chemical laboratory in charge of a skilled

metallurgist. The furnace will not be devoted entirely to the manufacture of ordinary mild-steel castings, but will also be used for manganese and other alloy steels, and the firm's products already include magnet castings, machine-moulded straight or helical tooth, worm, bevel wheels and pinions.

There are two iron foundries, each having 130 ft. by 40 ft. of floor space. They are furnished with metal by two drop-bottom cupolas of the Evans type. The larger one has a capacity of four tons per hour, and the smaller two tons. Wind is supplied by Root's blowers of the non-roller type.

One of the iron foundries is served by a 10-ton "Morris" overhead electric travelling crane.

FIG. 3.—FILLING MOULDS, MESSRS. A. HAMILTON & SONS, LIMITED.

Castings weighing up to 20 tons are turned out from this shop.

For moulds which require drying there are two coke-fired stoves, the larger of which is 20 ft. by 25 ft. and the smaller 10 ft. by 16 ft. An annealing furnace is in course of construction.

The brass foundry, which is supplied with metal by six natural draught crucible furnaces, can make castings weighing up to two tons.

The works possess their own pattern shops, which are replete with the latest electrically-driven machinery.

A speciality of this firm is the manufacture of all types of propellers.

ARGENTINE STATE RAILWAY REQUIREMENTS.—The Commercial Secretary to his Majesty's Legation at Buenos Aires (Mr. H. O. Chalkley) has telegraphed to the Department of Overseas Trade that the Argentine State Railways have called for tenders for the supply of the following material:—Brass sheets, copper sheets, copper bars, bolts, nuts and washers, steel bars, steel sheets, screws, cast steel for springs, steel rivets for boilers and coach-screws. Local representation by a resident agent is essential. United Kingdom firms who are not represented in the Argentine and who wish to be in a position to submit tenders may care to arrange with the London office of some Buenos Aires firm to present their tenders. Names of suitable firms will be furnished on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The Commercial Secretary is forwarding by mail specifications relating to these contracts. These documents will, on arrival, on or about September 21, be available for inspection by United Kingdom manufacturers and exporters on application to the Enquiry Room, Department of Overseas Trade.

Growth of Length Gauges.

In reporting on the results of some tests made on standard gauges, as recorded in its recently issued report for 1920, the National Physical Laboratory recalls the well-recognised fact that hardened steel is liable to change its dimensions slightly with time. This variation in size may be either plus or minus, and is probably due to the intense strains which are set up in the body of the metal when the temperature is suddenly reduced about 700 deg. C., as occurs in hardening. The tendency to change is minimised by tempering the steel or by other processes which have the effect of relieving the internal strains. As an example of this change of size the following case may be cited:—

During the war the National Physical Laboratory purchased several additional sets of standard slip gauges of a well-known Continental make. These sets were standardised by comparison with a standard set of the same make bought in 1908. After several months the comparison of the larger gauges was repeated, and it was found that the differences between the corresponding pairs of gauges from the old and the new sets had changed, and, moreover, the change was in the same direction on the different sizes of gauges. Now the pre-war history and the age of the early set of gauges indicated that this set was free from any appreciable secular change, so that suspicion fell upon the new sets. The comparison was repeated at intervals of a few months, and the evidence of change in the new sets was confirmed.

The results of a series of observations made at intervals in 1917-1920 show that the 1-in., 2-in., 3-in., and 4-in. gauges of one of the sets obtained in 1917 are growing at a rate of about 0.000006 in. per inch-length per annum. This rate of growth is practically constant for the different length gauges. The most recent measurements in August, 1920, tend to show that the rate of growth of the new set is diminishing appreciably. Such variations of size in this type of gauge are serious when they are used as standard or reference gauges. The particular set used at the Laboratory is checked periodically against permanent standard gauges every few months and the accepted sizes adjusted.

Periodic measurements were made on a number of alloy bars prepared in the Metallurgy Department, both before and after heat treatment. Some were found to be practically permanent in size, whilst others changed appreciably with time.

Foundry Reorganisation.—Part II.

By H. W. J.

When the foundries of this country are examined it is apparent that in the majority of cases very little attention has been paid either to the building or the lay-out, the result being that there is a tremendous wastage. This applies not only to foundries catering for the needs of a variety of customers, but also to foundries forming part of a general engineering establishment. This article, however, deals only with the first-named, leaving the general engineering foundries to be dealt with later.

It is not suggested that modern and up-to-date foundry buildings do not exist, but it is certain that these are in a minority. So many places, dignified by the appellation of "foundry," are, however, nothing but mere sheds, that the casual observer would declare at once that they could not possibly pay.

They are not all old-established places, for some three years ago the writer was invited to visit a foundry just lately established, and found it a mere collection of sheds. Why it should have been so, seeing that the company had an option on the surrounding land and that there were orders in abundance, appeared to him a mystery. Such, however, was the case, and it seemed to prove that, so far as foundry work was concerned, factory organisation was not understood.

Some of these collections of sheds paid well, because the demand for castings was so insistent that no matter what price was asked it was paid. To-day, however, a different situation has arisen, and now the owners of these foundries are finding it a difficult matter to keep going.

Assuming that they have not the money to demolish the "shacks" and erect substantial buildings, it is possible, by interior re-organisation, to increase materially the productive value of their premises, and so, for the purposes of illustration, one of these concerns will be taken and examined to see if it is possible to make it a paying proposition.

In the first place the building is draughty, leaky, and badly lighted. Doors are placed in such positions that at every period of the day the workers are exposed to draughts, these causing great loss of time on account of sickness. No man can work continuously in a draught, especially in a heated atmosphere, without feeling ill effects, and so it is apparent that to minimise lost time on account of sickness steps must be taken to make the place a more healthy one in which to work.

The leaky roof must also be considered in this connection, and so a survey of the building will result in long overdue repairs being effected. Certain doors are closed permanently, the position of others is altered, the roof is made weatherproof, and the improved health of the workers is reflected in the decrease of time lost owing to sickness.

Whilst these little changes are taking place, the question of lighting may also be considered. It cannot be argued that the moulder works better in the dark, but that would apparently be the view of those who devised the foundry, judging by the result of their handiwork. So many of these foundries are as forbidding as dangerous, and to expect efficiency from those who have the misfortune to labour inside shows a lamentable ignorance of the limits of human endurance.

It is so easy to get light, and it is not an expensive matter. Light begets cheerfulness, and cheerfulness is conducive to efficiency. We know that many foundries are so constructed as to make it difficult to admit more light without extensive alterations involving considerable expense, but the fitting of prism glass to existing window frames and skylights will make a wonderful difference.

One hundred, or even £50, will bring natural light into the dismal foundry, and the owner cannot do better than to call in an expert, who will give advice free of charge, and follow up with an estimate and a guarantee. It will be found that a transformation has been effected in the foundry, and work therein will become almost pleasant.

Even when there is a plentiful supply of windows they are not always used to the best advantage, for it seems to be the fashion to allow the glass to become so blurred with dust and dirt that for lighting purposes the windows are almost useless. It is known that the foundry cannot be a particularly clean place, and that dust is for ever flying about, but it will pay to keep the windows clean. Daylight must be welcomed, not repelled, and the sooner the dirty windows (so erroneously supposed to be the outward sign of industrial prosperity) are attended to, the better it will be for the worker, the manager, and the owner.

Artificial lighting, too, must be considered, and the feeble rays of the few low candle-power lamps, set a good distance apart, supplemented by the installation of an adequate lighting system. Bad lighting is responsible for many troubles. In the first place there is the general discomfort, occasioned by the gloom, which makes the worker sullen and taciturn. He arrives in the morning and departs in the evening, but he exhibits no enthusiasm or interest in his work. He is depressed, and that depression he cannot lose. It cannot be expected that a good day's work is to be obtained from a man in that condition.

Then there is the eye strain, which quickly develops into nerve strain. This manifests itself by the jumpiness and irritability of the workers, and is worse than mere depression

Last but not least insufficient lighting increases the risk of accident, which everyone wishes to avoid. In the foundry, even under fair conditions, accidents are by no means infrequent, and every effort possible must be made to obviate them.

Can we now say that this foundry has been overhauled and that although the structure has not been interfered with to any appreciable extent many important changes have been effected? The place is now fairly well ventilated and weatherproof, whilst there is a plentiful supply of daylight supplemented by artificial light when this is needed. Let us now see what we have gained.

In the first place our workers are more cheerful and regular—there is not so much time lost owing to sickness as formerly, and they display an unwonted interest in their work. This means that the output per man is increased, thus cheapening production so far as overhead charges are concerned. And apart from the fact that output is increased, the quality of the product is better, for with the development of the workers' interest more care is taken over the job and "wasters" are not so frequent.

Another point to be remembered is that good workers need attracting. In the dirty old foundry there were workers, but many of them could not, even by a big stretch of imagination, be termed first class. They were there simply because first-class moulders would not enter such service.

The question of wages is not always the determining factor, for the dirty old-fashioned foundries pay as well as most—and better than some—yet they do not get the class of labour desired. Many workers will accept lower wages if they are assured of decent working conditions, and, apart from this, there is the dignity of the worker, which does not always receive the notice it merits.

Many workers are sensitive about their place of employment, and often the statement is made that "I wouldn't work at So and So's for double pay." It is not that So and So's is such a bad place, but there is something about it which upsets the dignity of the worker. "Fancy pointing out *that* place to one's friends, and telling them you work there." There is a world of disgust in the tone of the statement, and it is a fact that many decent workers are extremely sensitive about the appearance of their place of employment.

Again, the value of a reference is (in the eyes of the worker) considerably diminished when it emanates from a foundry of unprepossessing aspect. "What would be the use of applying to a decent foundry for employment and stating that I have been working for So and So. I should be labelled third rate at once." There may be no truth in this assumption, but the good worker thinks so, and so we are deprived of his services.

It is necessary, in the interests of economical

production, to attract the really skilled worker, and by "skilled" is meant the man who, in his own particular line, will give value for money. The man wanted is the one who will produce good castings quickly and without much supervision.

The boys must also be attracted nowadays. This is a very difficult matter. The boy looks at the moulder and sees in him a somewhat depressed and careworn man. He looks at the foundry, and he sees nothing but a conglomeration of scrap heaps, dirt and grime—and he won't have it. So foundries must be transformed, and in so doing it is necessary to transform the moulder in order to bring boys into the foundry.

Some foundry managers aver that it cannot be done, and under existing conditions they are probably right. But work has to be carried on, and young labour is necessary. Undoubtedly it *has* to be done, and the necessary steps must be taken to ensure it. The small foundry is the best training school, and it is to the small foundry therefore that one looks for a lead.

A foundry may be situated in very indifferent surroundings, where the joys of living are not so very apparent, but the immediate surroundings at all events can be improved. The foundry may be badly constructed, but it can be made, if not attractive, at least presentable. The foundry is in existence, and it must either be made to pay or be closed down. There is no middle course.

The owner does not wish to close down, and he spends money in the endeavour to obtain business. That money is, however, lost unless he can offer inducements to buy, and those inducements consist of the offer of good quality castings at a competitive price. He can only do this if he has the right type of workers, and these working under conditions which will permit of economical production. It is better therefore for him to first spend a little money to procure those conditions, and having obtained these he can go all out for business, knowing that at all events he has the chance equal to that of his competitors.

An Appreciated Gift.

The members of the London Branch of the Institution of British Foundrymen will be pleased to learn that their Council has received from Sir Frederick Preston, K.B.E., J.P., the Chairman of Directors of Messrs. J. Stone & Company, Limited, a cheque for £10 10s. to enable the Branch to purchase a lecture lantern.

Foundry Trade Exhibition, Munich, 1921.

In connection with the 51st general meeting of the Association of German Foundry Unions in Düsseldorf an exhibition will be held from September 14 to 25 next in the Exhibition Park in Munich (Bavaria). Besides numerous kinds of machinery, furnaces, ovens, tools, and materials used in the foundry trade, there will be also on view a collection of artistic foundry work. The Association of German Foundry Experts, the Association of German Steel Foundries, and the Whole Union of German Metal Founders will hold meetings in Munich during the period of and in connection with the Exhibition.

A NEW STAMPED STEEL GAGGER.—The United Compound Company, of Buffalo, N.Y., have put upon the market a novel gagger. It is made of steel, of approximately one-sixteenth of an inch in thickness, and an inch wide. This is stamped into the form of the letter U, with an opening of about half an inch. This half-inch opening is pinched in to about a quarter of an inch at every inch in the length of the bar. Bars of this shape are bent to a right angle and of whatever dimensions required. When completed, the gagger has a small surface to rest over the pattern when rammed into a mould, thereby giving little chance for it to scab off. It is light although rigid, and being irregular in outline, should take a good hold of the sand.

Brazilian International Exhibition, 1922.

The Centenary of the Independence of Brazil will be celebrated at Rio de Janeiro in the autumn of next year. In connection with the celebrations there will be an extensive Brazilian National Exhibition, and also an International Exhibition, and a number of nations have been invited to participate, and many of them, it is understood, have already accepted the invitation. The celebrations will be on a very large scale, and will include an international naval display. It is not unlikely that it will be largely attended by the peoples of all the South American States, and will afford an unusual opportunity for those interested in trade with Brazil to develop their business.

The social atmosphere in Brazil is said to be most favourable towards the British Empire. The friendship is the result of long association and the vast British interests which have been developed in Brazil over a long period of years, notably in connection with their railways. It is calculated at the present time that there are nearly 300 millions of British capital invested in the country, which, at the same time, is being subjected to intensive propaganda by rival nations.

It is probable that official participation by the Empire will be decided upon at an early date. Owing to the limitations of space available for the erection of national pavilions, such participation fortunately need not entail very much expenditure, but while it affords opportunities for collective exhibits on behalf of the various nations of the Empire and of those manufacturers and commercial bodies most intimately interested, it is insufficient to provide space within the national pavilion for individual exhibits of Britsh firms.

It is understood, however, that space for these is available to the extent of some 100,000 superficial feet on adjoining quays, and that it may be found possible to provide space within the city itself for exhibits to be made.

In the opinion of the British Chamber of Commerce in Brazil the opportunity afforded to British manufacturers, not only of the United Kingdom but of the whole Empire, is a unique one, and should not be lost sight of.

The exhibition will open some time early in September, and it is hoped that full information may be available at an early date.

It is understood that the exhibition area will extend from the southern end of the Great Central Avenue, Calle Rio Branco, to the old Arsenal, the latter site being occupied by the Brazilan National Exhibit, while the International Pavilions will be ranged along the sea front facing on to what is unquestionably the finest harbour in the world. Provided certain difficulties which have arisen in connection with the site can be overcome, the exhibition promises to be an unqualified success, and to rouse the greatest enthusiasm and interest in both the American continents.

Fit of Commercial Bolts and Nuts.—An investigation into the fit of commercial bolts and nuts carried out for the British Engineering Standards Association by the Natural Physical Laboratory has shown that a considerable proportion of the tolerances allowed on the effective diameters is virtually absorbed by defects of thread form and pitch. With the quality of thread form at present found in commercial screws, nuts and bolts are not by any means interchangeable, although they may be wholly inside their respective tolerances on effective diameter as measured in the usual way.

A NEW AUSTRALIAN BRIDGE.—Tenders are invited by the Department of Public Works, Sydney, New South Wales, for the manufacture, supply and delivery of the metalwork for the Lift Bridge to be constructed over the Murray River at Tooleybuc. The specifications and conditions, forwarded by H.M. Trade Commissioner at Sydney, can be inspected by United Kingdom firms interested on application to Room 59, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1. Plans for this work are in the possession of the Consulting Engineer in London to the New South Wales Government, 64, Victoria Street, S.W.1, where they may be consulted by British firms interested.

XUM

Gear Patterns.*

By H. J. McEaslin.

In practice these theoretical curves are rarely laid out, approximates being used which are obtained by means of circular arcs. The radii for these circular arcs are commonly obtained from odontograph tables. In Grant's work on "Gearing," he gives an involute odontograph table from which radii for various sizes of gears can be obtained. Fig. 1 illustrates a method of laying out an involute tooth by means of this odontograph table.

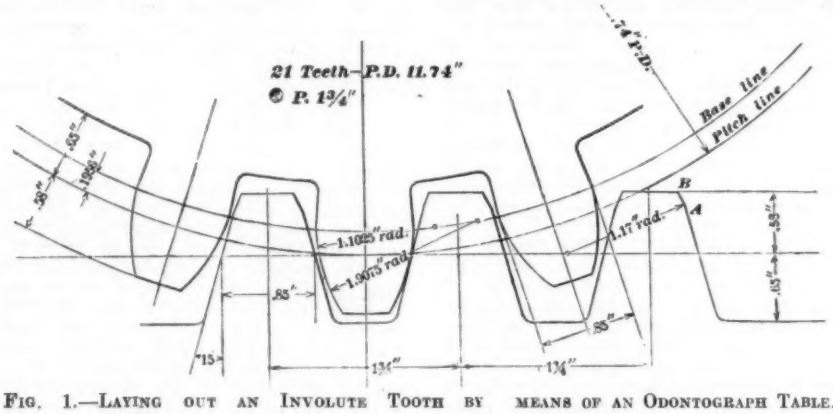


FIG. 1.—LAYING OUT AN INVOLUTE TOOTH BY MEANS OF AN ODONTOGRAPH TABLE.

The pitch circle or pitch line should be drawn first and the addendum line drawn outside the pitch line at a distance from it equal to one divided by the diametral pitch or to 1-3 of the circular pitch. The dedendum line should be drawn inside the pitch circle the same distance, but in practice this is not used, the root line being inside of the pitch line by a distance equal to 9-8 of the addendum.

GRANT'S INVOLUTE ODONTOGRAPH.
Standard Interchangeable Tooth, Centres on Base Line.

Teeth.	Divide by the diametral pitch.		Multiply by the circular pitch.	
	F. Face radius.	G. Flank radius.	F. Face radius.	G. Flank radius.
10	2.28	.69	.73	.22
11	2.40	.83	.76	.27
12	2.51	.96	.80	.31
13	2.62	1.09	.83	.34
14	2.72	1.22	.87	.39
15	2.82	1.34	.90	.43
16	2.92	1.46	.93	.47
17	3.02	1.58	.96	.50
18	3.12	1.69	.99	.54
19	3.22	1.79	1.03	.57
20	3.32	1.89	1.06	.60
21	3.41	1.98	1.09	.63
22	3.49	2.06	1.11	.66
23	3.57	2.15	1.13	.69
24	3.64	2.24	1.16	.71
25	3.71	2.33	1.18	.74
26	3.78	2.42	1.20	.77
27	3.85	2.50	1.23	.80
28	3.92	2.59	1.25	.82
29	3.99	2.67	1.27	.85
30	4.06	2.76	1.29	.88
31	4.13	2.85	1.31	.91
32	4.20	2.93	1.34	.93
33	4.27	3.01	1.36	.96
34	4.33	3.09	1.38	.99
35	4.39	3.16	1.39	1.01
36	4.45	3.23	1.41	1.03
37—40	4.20		1.34	
41—45	4.63		1.48	
46—51	5.06		1.61	
52—60	5.74		1.83	
61—70	6.52		2.07	
71—90	7.72		2.46	
91—120	9.78		3.11	
121—180	13.38		4.26	
181—360	21.62		6.88	

Draw the rack tooth by the special method.
(*From Grant's Treatise on Gear Wheels.*)

The base line is drawn inside the pitch line by a distance of 1-60 of the pitch diameter. To draw a gear proceed as follows:—The figure shows several teeth of a gear having 21 teeth 11.74 inches pitch diameter and 1¾ in. circular pitch. The gear is also shown in contact with the rack. After the various circles have been drawn the pitch circle should be spaced for the pitch points by stepping off with a pair of dividers or any other convenient method.

In the odontograph table, opposite the 21 teeth and under the face radius is found the number 1.09. This must be multiplied by the circular pitch of the gear and gives 1.907. With the dividers set to this face radius of 1.907 draw the face of the teeth from the addendum to the pitch circle, keeping one point of the dividers on the base line as a centre. If the number of teeth is greater than 36 or if the pitch is small, this face radius should be extended to the base line. In the case under consideration, opposite 21 teeth in the table and in the column headed Flank Radius is found the figure .63, and this, multiplied by the circular pitch, gives 1.102. With the dividers set to this radius and the centre on the base circle, draw the flanks of the teeth from the pitch circle to the base circle. From the base circle continue the flanks of the teeth to the root circle by straight radial lines, and round the roots of the teeth with a fillet.

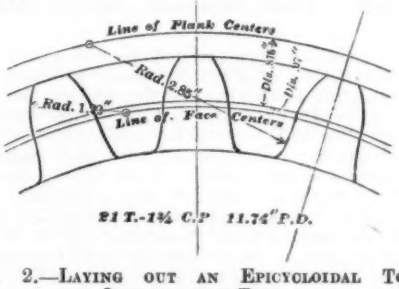


FIG. 2.—LAYING OUT AN EPICYCLOIDAL TOOTH ODONTOGRAPH TABLE.

To lay off the rack teeth it is first necessary to draw a straight line for the pitch line and two parallel lines for the addendum and root lines. The sides of the teeth are drawn through the pitch points at an angle of 15 deg. from the perpendicular, as shown in Fig 1.

The point of the tooth from the point A, Fig. 1, to B, must be rounded by an arc drawn from a centre on the pitch line, and with the dividers set to a radius equal to 2.10 in. divided by the diametral pitch or the circular pitch multiplied by .67. In the case under consideration, multiplying .67 by the circular pitch we obtain 1.17 as the radius to be used.

Epicycloidal Odontograph Tables.

Grant has also prepared an odontograph table giving the proportions of epicycloidal teeth. To

* Extracted from the "Canadian Foundryman."

apply this table in laying out the gear shown in Fig. 2 the following is the procedure:—

The gear has 21 teeth, 11.74 in. pitch diameter and 1¾ in. circular pitch. The pitch circle, addendum and root circles should be drawn. The pitch points should also be marked on the pitch circle.

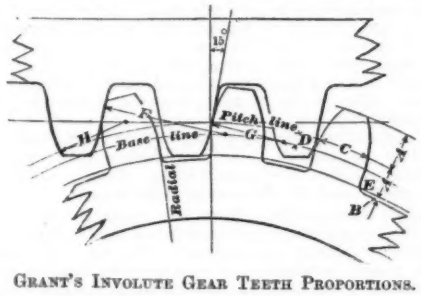
The flank centre distance for 21 teeth is .5, and multiplying this by the circular pitch the figure .875 is obtained as the distance between the pitch circle and the line of centres for the flanks. This circle should be drawn as shown in Fig. 2. From the table it is found that the factor for the face

GRANT'S EPICYCLOIDAL ODONTOGRAPH

Standard Cycloidal Teeth—Interchangeable series.
From a Pinion of Ten Teeth to a Rack.

Number of Teeth in the Gear.		For One Diametral Pitch. For any other pitch divide by that Pitch.				For One Inch Circular Pitch For any other Pitch Multiply by that Pitch.			
		Faces.		Flanks.		Faces.		Flanks.	
Exact	Intervals	Rad.	Dis.	Rad.	Dis.	Rad.	Dis.	Rad.	Dis.
10	10	1.99	.02	— 8.00	4.00	.62	.01	—2.55	1.27
11	11	2.00	.04	—11.05	6.50	.63	.01	—3.34	2.07
12	12	2.01	.06	∞	∞	.64	.02	∞	∞
13½	13—14	2.04	.07	14.50	9.43	.65	.02	4.60	3.00
15½	15—16	2.10	.09	7.86	3.46	.67	.03	2.50	1.10
17½	17—18	2.14	.11	6.13	2.20	.68	.04	1.95	.70
20	19—21	2.20	.13	5.12	1.57	.70	.04	1.63	.50
23	22—24	2.26	.15	4.50	1.13	.72	.05	1.43	.36
27	25—29	2.23	.16	4.10	.96	.74	.05	1.30	.29
33	30—36	2.40	.19	3.80	.72	.76	.06	1.20	.23
42	37—48	2.48	.22	3.52	.63	.79	.07	1.12	.20
58	49—72	2.60	.25	3.33	.54	.83	.08	1.06	.17
97	73—144	2.83	.28	3.14	.44	.90	.09	1.00	.14
290	145—300	2.92	.31	3.00	.38	.93	.10	.95	.12
∞	Rack	2.96	.33	2.96	.34	.94	.11	.94	.11

In the odontograph table, opposite 21 under the head of circular pitch and the faces of the teeth, 0.04 is given as the factor for obtaining the distance of the circle of centres from the pitch circle.



GRANT'S INVOLUTE GEAR TEETH PROPORTIONS.

Circular pitch.	A.	B	C.	E.	H.
1	.33	.04	.49	.08	.67
1⅛	.37	04	.55	.08	.75
1¼	.41	05	.61	.10	.83
1⅜	.45	05	.67	.10	.91
1½	.50	.06	.73	.12	1.00
1¾	.58	.07	.85	.14	1.17
2	.66	.08	.98	.16	1.34
2¼	.75	.09	1 10	.18	1.50
2½	.83	.10	1.22	.20	1.67
2¾	.91	.11	1.34	.22	1.84
3	1.00	.12	1.47	.24	2.01
3⅛	1.08	.13	1.59	.26	2.17
3½	1.16	.14	1.71	.28	2.34
3¾	1.25	.15	1.83	.30	2.51
4	1.33	.16	1.96	.32	2.68
4¼	1.41	.17	2.08	.34	2.84
4½	1.50	.18	2.20	.36	3.01
4¾	1.58	.19	2.32	.38	3.18
5	1.66	.20	2.45	.40	3.35
5¼	1.75	.21	2.57	.42	3.51
5½	1.83	.22	2.69	.44	3.68
5¾	1.91	.23	2.81	.46	3.85
6	2.00	.25	2.94	.50	4.02
6½	2.16	.27	3.18	.54	4.35
7	2.33	.29	3.42	.58	4.69
7½	2.50	.31	3.67	.62	5.02
8	2.66	.33	3.92	.66	5.36
8½	2.83	.35	4.16	.70	5.69
9	3.00	.37	4.41	.74	6.03
9½	3.16	.39	4.65	.78	6.36
10	3.33	.41	4.90	.82	6.70

D or distance to the base line equals 1-60 of pitch diameter.

Multiplying the circular pitch by this we have .07, and hence a circle must be laid off at this distance inside the pitch circle.

radius of the 21 teeth is .70, then multiplying the circular pitch by this factor we have 1.22. With the dividers set to this radius, and keeping one point on the circle of face centres the faces of all the teeth should be drawn. From the table the factor for the radius of the flanks of the teeth corresponding to 21 teeth is given as 1.63, and

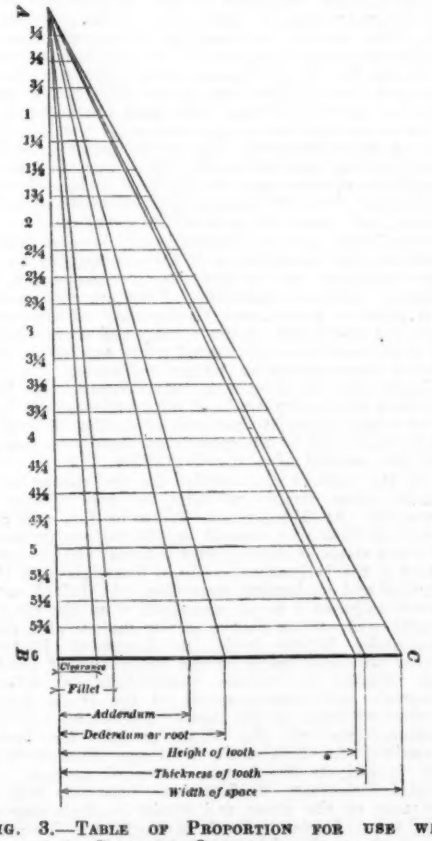


FIG. 3.—TABLE OF PROPORTION FOR USE WITH INVOLUTE ODONTOGRAPH.

multiplying the circular pitch by this we have 2.85. With the dividers set to this radius and one point on the circle of flank centres, we should draw the flanks of the teeth. Small fillets should then be drawn at the base of each tooth, thus completing the tooth outline.

Proportions of Tooth Parts.

Grant has prepared a table of proportions of tooth parts for use in connection with his involute odontograph. For convenience, however, in obtaining this information quickly for different pitches, a diagram as shown in Fig. 3 may be used. This diagram is for the extra short involute tooth, and gives proportions of teeth from ¼ in. to 6 in. circular pitch. Such a diagram can be made for teeth of any proportions, and will be found a great time-saver on account of the fact that its use reduces the calculations necessary.

In laying out such a table A-B represents the greatest pitch required—in this case, 6 in. The perpendicular B-C is used for laying off the various proportions for 6-in. circular pitch. After these points are laid off they are connected with the point A by a series of diagonal lines. In order to obtain the proportions for any other tooth it is only necessary to erect a perpendicular at a distance from A corresponding to the circular pitch desired. In the illustration, perpendiculars have been drawn corresponding to all circular pitches between ¼ in. and 6 in., varying by quarters of an inch. The proportions of this short involute tooth are as follows:—Addendum equals 2-10 circular pitch. Dedendum equals 5-100 circular pitch, plus .01 of an inch. The thickness of the tooth equals 47-100 of the circular pitch.

Materials used in Aeroplane Construction.

From the report of the Aeronautical Research Committee for the year 1920-21, just to hand, we give the following extracts relating to metals and alloys used in aeroplane construction:—

In the National Physical Laboratory the fatigue ranges of steels under complex stress distribution are now in hand, as also the development of a thermometric and other rapid methods for determining fatigue ranges; the effect of high temperatures on the fatigue properties of steels and the determination of the most suitable materials for fundamental research on the structure of metals will shortly be commenced.

In the Metallurgy Department the methods of melting and casting aluminium alloys with special reference to current problems have been continued on the lines commenced under the auspices of the late Light Alloys Sub-Committee. The investigation of casting temperatures, contraction during casting, fatigue and repetition stresses are also in hand, while the constitutional work on thermal equilibrium diagrams for binary and ternary alloys is not being neglected.

The Royal Aircraft Establishment have in hand a mathematical investigation of the stresses due to surface scratches, rate of variation of cross section and internal cracks in materials. They are also making a number of experiments on the effect of alternating torsional over-strain on the density and elastic moduli of steel, the fatigue of riveted joints and on the effect of low temperatures on fatigue resistances.

Light-alloy work at this establishment is being directed to foundry trials of all promising new light-alloy compositions; to methods of casting light alloys on to steel; and to the growth of aluminium castings and the method of electro-deposition.

At the various Universities the programme of research relates mainly to work on the fatigue of materials. At Birmingham, Professor Lea will commence an extensive research on the fatigue properties of valve steels at various temperatures, and the correlation of the fatigue properties of materials with their physical and mechanical properties. At Oxford, attention is to be paid to an investigation on the effect of scratches at various depths on the surface of a specimen under fatigue loads. At Liverpool, Professor Mason will experiment on the application of bending and twisting in various proportions to different materials, with measurements of the cyclic strains. Professor Gibson, of Manchester University, will make measurements on the three moduli for various materials. At Edinburgh, Professor Hudson Beare will investigate the fatigue on spiral springs. At Bristol University, Professor A. Robertson will experiment on the stress and strain in steels near the yield point; Professor Desch, at Sheffield, will continue his work on the electro-deposition of cadmium and nickel for the protection of aeronautical structures from corrosion.

Fatigue of Materials.—A report describing some experiments on the fatigue of materials under alternating torsion has been communicated by the N.P.L. From a number of tests on a 0.65 per cent. carbon steel the following conclusions have been drawn:—

(1) That the fatigue limit under reversed shear stresses is marked by a "breakdown" or "yield" point in the material, as in Smith's experiments with direct stresses.

(2) That this breakdown point is independent of the form of the section (solid or hollow).

(3) That Guest's law applies to fatigue stresses.

The Paper, which will shortly be published, is of special interest as the time taken to determine the fatigue limit of one specimen by the new method is only from 3 to 15 minutes. Owing to the fact that the maximum stress occurs only at one section, the breakdown will probably be visible as an elastic limit effect rather than as a yield effect; consequently a quick method is possible for determining the fatigue limit.

A number of notched-bar impact tests on steels at low temperatures has been completed at the N.P.L. They show that with mild steel there is a very large reduction in the energy absorbed in breaking a notched test piece when the temperature is reduced to — 38.5 deg. C. and below. This reduction in the energy absorbed is attributed to the presence of notches. With reference to these and similar tests, attention has been drawn to the scale effect obtaining in them, particularly in the case of notched-bar impact tests. This has been taken account of by a note on the subject which draws attention to the fact that the time of fracture ranges from one to four-thousandths of a second, so that many more reflections will occur in some cases, during the process of fracture. It seems probable that much of the measured work of fractures will have been propagated through the swinging arm into parts of the apparatus where it will be lost by dissipation, so that there will be a certain "missing quantity" of the experiment which will not necessarily be a constant fraction of the whole, but will depend upon the time of fracture, *i.e.*, upon the striking velocity.

The effect of heat treatment on the value of a modulus (Young's modulus) has also been ascertained at the N.P.L. The maximum effect due to heat treatment alone was found in the case of the 2¾ nickel and 0.25 carbon steel to be 4 per cent. Other experiments show the modulus of rigidity can be readily obtained to an accuracy of within 1 per cent. The tensile stress of steels with high percentage of carbon is another matter that has been investigated, and it is found that these materials have a high-tensile stress at high temperatures, and that this strength is nearly equalled by high-chromium steels also containing a high percentage of carbon. In considering these tests, it becomes evident that a percentage of carbon plays an important part in determining the stress.

Light Alloys.—Tests have been made at the N.P.L. on rivet material and riveted joints, which lead to the following general conclusions:—The use of various soft rivets consisting of nearly pure aluminium in structural work does not appear to be necessary, since perfectly satisfactory joints can be made using either cold drawn and annealed wire of 3/20 alloy or duralumin wire; and, since both these materials give very much higher shear stresses than soft aluminium wire, there is every reason in favour of the use of the harder material.

A number of tests have been made on pure nickel, which was considered a possible suitable material with which to carry out experiments on combined stresses. From the load extension diagram of this material it can be seen that the metal begins to yield at about 3.5 tons. It then continues along the plastic curve to a maximum load of 9.75 tons. Whether nickel would prove a better material than steel for the general research proposed is still under consideration.

Strength and Weight of Aeroplane Structure Materials.—A paper drawing attention to the general relations established between the strengths required by different materials in order to produce structures of equal weights has been communicated to the Committee, and has since been published. The following results were obtained:—

(1) For the flanges of members subjected to bending, either simple or accompanied by axial loading, 45-ton steel will have the same weight as duralumin.

(2) For strut members the steel used requires a modulus of elasticity of 13,200 tons/sq. in. to reduce the weight to that of equally strong duralumin members.

(3) The flexibility of steel and duralumin beams will be equal if 45-ton steel is used. For higher grades, steel construction is more flexible than duralumin.

From the foregoing it would appear that for small craft, where the thicknesses of steel required would be impossibly small, duralumin gives a lighter construction. For large aeroplanes, however, steel appears undoubtedly the better material.

XUM

Trade Talk.

THE CLYDE SHIPYARD JOINERS resumed work on August 25.

A DISCOVERY of a large body of high-grade hematite iron ore in the Elk Lane district of Northern Ontario has been reported.

MESSRS. JOHN TONKS & COMPANY have removed to the Hallcar Steel and Spring Works, Rutland Road, Neepsend, Sheffield.

THE MEN EMPLOYED at the Crewe Foundries of the London & North-Western Railway Company have been placed on short time.

A PETITION for confirming the reduction of the capital of P. R. Jackson & Company, Limited, from £120,000 to £60,000 is now pending.

THE FIRST FURNACE to be lighted at Workington since March last was blown in by the United Steel Companies, Limited, last week.

INQUIRIES RELATING to the Safeguarding of Industries Act should be addressed to the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Great George Street, S.W.1.

AFTER 14 YEARS the Cunarder "Mauretania," built by Swan, Hunter & Wigham-Richardson, Limited, is to revisit the river Tyne for purposes of reconditioning An oil-burning installation will also be fitted.

MESSRS. BALDWINS, LIMITED, who are restarting their big steelworks at Port Talbot, confirm the report that they have secured a contract for 17,000 tons of steel rails, intended for the projected railway in China.

MR. T. LUMLEY, of Tansley, has purchased a block of shares in 123 disused lead mines situated in eleven parishes of Derbyshire. The mines were part of the property of Wass & Son, of the famous mill close to Darley Dale.

THE INSTITUTION OF NAVAL ARCHITECTS SCHOLARSHIP (1921) has been awarded by the council of the Institution to Mr. S. A. Hodges, and the Earl of Durham Prize to Mr. T. A. Davies, both of H.M. Dockyard, Portsmouth.

THE 15,500-ton steamer "London Maru," the largest vessel built for Japan for many years, was launched at Messrs. Cammell, Laird's yard at Birkenhead last week She is the best ship of her class owned by the Japanese.

ALFRED HICKMAN, LIMITED, are re-starting their Spring Vale Furnaces, near Wolverhampton, and the Staffordshire Steel and Ingot Ironworks, Bilston. It has also been decided to re-commission the furnaces of Lloyds' Ironstone Company, Limited, at Corby, Northamptonshire.

ARRANGEMENTS are now being made by the Institution of Automobile Engineers for holding a series of informal meetings before the London, Birmingham, Manchester and Glasgow Centres during the winter. These meetings are designed to bring before the members new accessories.

BY ORDER OF THE DISPOSALS BOARD it was announced, on Tuesday, that instructions have been given for the sale of the stock of machine tools and electrical plant now lying in disuse in the munition towns of Georgetown (near Glasgow), Gretna Green, and, in a less degree, at Irvine (Ayrshire), and Shandon (River Clyde).

OUR readers may be reminded that the autumn meeting of the Institute of Metals will be held in Birmingham, on September 21, and two following days. It is expected that a large proportion of the 1,400 members of the Institute will be present at the meeting, which will be of importance to engineers, metallurgists, and chemists.

A RECENT cable advice from New York states that the Inter-State Commission has authorised the railways east of the Mississippi to reduce their rates on iron and steel products for export 20 to 25 per cent. The industry had urged the reductions on the ground they were necessary to enable Americans to meet competition from abroad.

THE Miscellaneous Trades Joint Council, after a conference with Government representatives, has agreed to a reduction in wages for both men and women workers in the Army Ordnance Air Disposal and Liquidation Depôts. The reductions, which are not so large as expected, will vary according to districts, the maximum being 3s. per week

WM. H. MULLER & COMPANY (LONDON), LIMITED (Ferro-Steel Department), Holland House, 1-4, Bury Street, London, E.C.3, intimate that they have recently established an additional department at the above address dealing with the distribution of all kinds of portable railway material, iron and steel, plates, nails, constructional work, etc.

THE dispute between the Southampton ship joiners and the London and South Western Railway Company has been satisfactorily settled. A large proportion of the men have returned to work in the shipyard, under terms of the national settlement, and it is anticipated that all the men, for whom there is work, will be shortly employed The dispute has lasted eight months.

THE ENGINE MANUFACTURING hitherto carried on by Petters, Limited, at their Nautilus Works, Yeovil, has been transferred to the Westland Works, in order that the best possible results might be obtained from the staple industry of the company. The Nautilus Works are now closed, and are in the market for sale, the company, in consequence, being relieved of considerable expenses.

THE SHIPBUILDING EMPLOYERS' FEDERATION have arranged with the Federation of Engineering and Shipbuilding Trades for a conference, to take place at the Central Hall, London, S.W., on September 23, to discuss the question of the cessation of the war bonuses. By Order in Council of August 10, the Government fixed August 31 as the date for the official termination of the war.

REPRESENTATIVES OF THE RAILWAY COMPANIES and the Amalgamated Engineers' Union have arrived at a provisional settlement of the questions at issue between that union and the National Union of Railwaymen. The matter, which concerns the conduct of negotiations for railway shopmen, will now come before the Railway Managers' Association and the executive of the A.E.U. for confirmation.

AN autumn campaign is being opened on September 17 by the National Federation of Professional, Technical, Administrative, and Supervisory Workers. At 11 a.m. on that date there will be a conference of representatives from purely clerical and administrative organisations, to consider the formation of a Standing Joint Committee to represent the combined views, as producers and consumers, of all such workers.

THE LIVE registers of the employment exchanges in the United Kingdom show that on August 19 there were approximately 1,640,600 persons wholly unemployed as compared with 1,686,919 during the previous week, a decrease of about 46,300. This total, which is a preliminary figure and subject to revision, is exclusive of short-time workers, who on August 12 numbered 470,100, a decrease of about 18,000 compared with the previous week.

THE COURT OF ARBITRATION appointed to consider a reduction of the "standard ship" cycle wage advances granted during the war to the skilled trades in the shipyards sat at Newcastle on Tuesday and Wednesday. The chairman was Sir William McKenzie, who was accompanied by Mr. James Fullerton, the employers' assessor, Mr. G. J. Rowe, assessor for the workmen, and Mr. A. Gunn, secretary to the Court, for the Ministry of Labour.

CLYDE SHIPBUILDERS launched during August 34 vessels of 34,616 tons, making a total for the eight months of 165 vessels of 299,864 tons. Of the August vessels, however, about 20 were small motor craft, and new trading tonnage was represented by only 13 vessels of about 34,500 tons. The eight months total is lower by over 140,000 tons than that of last year at the corresponding date, and much lower than the average of the previous two decades.

IN RESPONSE TO AN INVITATION by the General Electric Company, Limited, a visit of inspection was paid by members of the Midland Branch of the Association of Mining Electrical Engineers on Wednesday, August 24, to the company's engineering works at Witton, Birmingham. At these works 3,000 persons are engaged, and altogether in the Birmingham district 5,000 are in the employ of the company. The site on which the works are erected covers 130 acres, and large extensions are now being completed. Mr. T. Evan Davies, general manager of the Witton works, presided at a luncheon to which the visitors were entertained at the Imperial Hotel, Birmingham.

MELDRUMS, LIMITED, Engineering Works, Timperley, near Manchester, have received orders for fitting their forced draught furnaces as follows:—Consett Iron Company, Limited, Consett, Co. Durham, furnaces to Lancs. boiler at cogging mill; W. C. Holmes & Company, Limited, Whitestone Ironworks, Huddersfield, furnaces to two stills; W. Whitwell & Sons, Limited, Thornaby Ironworks, Stockton-on-Tees, furnaces to three B. & W. boilers; J. C. Hill & Company, Limited, Oakfield Steel Wire Works, Cwmbran, Mon., forced draught blowers to reheating furnace; Harland & Wolff, Limited, Belfast, large refuse destructor furnace for raising steam from shipyard refuse, this is a repeat order.

THE appeal of Sheffield steel manufacturers against the imposition of prohibitive American import duties on steel was placed before the Senate Finance Committee at Washington recently. Mr. Arthur Balfour, as head of a deputation from the Sheffield Chamber of Commerce, appeared before the Committee, and stated that British steel makers asked for no favouritism, and never dreamed of any retaliatory measures. He told the Committee that the rates proposed on high-speed steel and tungsten in the Fordney Tariff Bill would send many British firms into bankruptcy. He suggested that a more equitable duty would be 35 cents, instead of 72 cents, on tungsten, and 10 per cent. *ad valorem*, instead of 20 per cent., on high-speed steel. He also protested against the feature of the Bill regarding American valuation.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Very slow progress on the road to recovery in the pig-iron industry can as yet be reported, and although to some extent more animation is observable in market movements, there is little in the way of actual business passing to justify optimistic views of the position. The stagnation of the past few months must inevitably take some considerable time to entirely overcome, and until consumptive demand becomes general, owners of furnaces can hardly be blamed for exercising extreme caution in resuming operations while working costs remain at present high levels. In the Midlands, for example, the recent cut in coke prices has not yet resulted in any marked increase in pig-iron production, smelters still holding firmly to their resolution not to start more furnaces until further reductions of fuel costs can be effected. The depression in the engineering industry curtails one important outlet for foundry grades, and, of course, the small iron founders do not require their normal quantities. If any castings were being made there would be a very poor sale for forge iron owing to the finished-iron works still being at a standstill. These two branches of the industry seem to be more or less waiting for each other. In the West of Scotland there has been a further small increase in the number of furnaces in blast, but in some quarters smelters still show hesitancy, as at present production is not regarded as a paying proposition, and in addition there is some difficulty in marketing outputs in face of the limited demand both on home and export account. In the latter market, however, inquiries are reported as slightly improved, transactions for some fair-sized parcels having been negotiated for the East. Prices for the leading qualities of pig at Glasgow, remain stationary for the present, and no substantial change can be expected until a downward revision of fuel costs has been accomplished. In Lancashire, much the same conditions as obtain elsewhere are observed. Derbyshire pig-iron smelters, who supply the bulk of local supplies, having so far only offered unimportant reductions in prices, while foundries with business almost at a standstill are only purchasing on a small scale at present. Lancashire in this respect suffers more than other districts, having to import iron chiefly from a distance, and in consequence consumers have to pay on the increased railway freight charges, greatly to the disadvantage of the trade. In the Cleveland iron market there is a distinctly more hopeful feeling of approaching activity, and the gradual extension of the number of furnaces in blast is confidently anticipated as the autumn advances. The view, however, is still entertained that coke continues too dear to make production profitable, but in market circles the impression grows that a further drop in fuel will shortly materialise. Foreign inquiries are few, as Cleveland prices are still too high, quotations now ruling nominally at 142s. 6d. for No. 1, both for home and export. What is now wanted is a substantial cut in Cleveland foundry and forge prices. The lower qualities have long been a drag on the market, and at 135s. No. 3 is regarded as far too dear. There seems to be a little more No. 3 offered now, so that the price may speedily be modified, but 135s is still quoted. No. 4 foundry, however, is freely offered at 125s., No. 4 forge and mottled at 117s. 6d., and white iron at 115s. per ton. The shipments of pig-iron during August amounted to 6,116 tons, of which 4,735 tons went coastwise and 1,381 tons abroad, as compared with 5,240 tons in July. The latter total comprised 2,035 tons coastwise and 3,205 tons abroad. The August coastal shipments included 2,680 tons to Wales and 1,375 tons to Scotland. The biggest foreign buyer was Belgium, with 681 tons, as against 1,460 tons in July, and 175 tons went to Holland.

Movements in the East Coast hematite trade indicate a further stage in the downward course of prices for mixed numbers, it having been decided at last week's meeting of the Tees-side ironmasters to reduce the current price of mixed numbers to the level of the export price, the quotation both for home and shipment now being 140s. per ton. This should serve to stimulate the home inquiry, for there was never any justification for the differentiation. In West Cumberland and North Lancashire there is also a little more stir in the market than has been observed since the spring of the year. West Coast hematite has been reduced another 10s. to £7, f.o.t., and £7 15s., delivered Sheffield.

Finished Iron.

Conditions in the finished iron section of the market continue, may be best described, perhaps, as in the transition stage, and little actual improvement is expected until quarter-day has passed. Works in the South Staffordshire district, with few exceptions, are at a standstill, as far as concerns fresh business, the absence of any buying tendency in markets being a notable feature of the present position. Demand on general account remains as quiet as previously reported, the best that can be said in this connection being a somewhat better inquiry for certain classes of finished material. A glance at the list of contracts open for finished iron, both on home and overseas account, will at once disclose the weakness of the situation. Although it is freely admitted that a vast amount of engineering and constructional work must be awaiting execution in Europe and more distant countries, the time is not yet ripe for placing even the most urgently required quantities. In Birmingham and the surrounding districts the marked bar mills are running almost, if not quite, full time, but in contrast, the common bar mills are running not more than three days a week. Demand even for the cheap Belgian bars for the nut and bolt industry is of small proportions, owing to depression in that industry, and when the revival does come there are abundant stocks to meet it. The home price of £16 for bars is reported to be cut in a few instances by firms outside the Association. The market for chain iron is also exceedingly slow, reflecting the state of the chain and cable industry in Cradley district. The condition of the Leeds engineering trades remains very serious, about 2,000 men in the district being unemployed or on systematic short time. Most firms are working short time, and almost daily are having to suspend additional numbers of men, owing to slackness of trade. At some of the local works orders are so few that only half the usual staffs are being engaged for three days in each fortnight. In the North-Eastern district the outlook in the finished iron industry may be regarded as rather more hopeful. Export inquiry, particularly from the Far East, is looking up, and works are competing keenly for all the business offering. The shipments of manufactured iron and steel from Middlesbrough during August show a gratifying increase of not less than 17,137 tons, the figures being 22,097 tons, as compared with 4,960 tons in July. Of the total, 2,772 tons went coastwise and 19,325 tons abroad. India and Ceylon took 4,634 tons, Africa 4,892 tons, Australia 2,957 tons, New Zealand 2,482 tons, and Uruguay 1,182 tons.

Steel.

Without much apparent alteration in the outlook it is significant that Sheffield manufacturers are gradually reducing their steel prices, while Continental competitors are raising theirs. There is now very little difference between them, especially considering the superior quality of the latter. Wage reductions have enabled manufacturers to bring down costs and prices also. That measures of this kind were essential is evidenced by a recent report from authentic German sources that whereas a few weeks ago it was necessary to proceed with restrictions in working all along the line, and even close unprofitable departments, orders for steel products are now accumulating every day. At the end of May it was almost impossible to sell steel bars at from 1,800 to 1,900 marks per ton, but now the price is 2,400 to 2,500 marks. The demand for export is specially surprising. The last-mentioned statement is of special interest to home manufacturers, implying as it does, the determination of our recent enemies to extend their activities in encroaching on foreign overseas markets, hitherto dominated by British influence. Last week's drop in the price of East Coast hematite to 140s., to correspond with the previous export quotation, has, so far, had no effect upon values of steel products in the Sheffield market at all events; but with the downward movement in fuel costs continuing unchecked, there will, doubtless, be a further revision shortly in that direction. In the meantime, business remains slack in most departments with, however, some exceptions, firms devoting attention to rolling-stock construction and repair work in Sheffield and elsewhere having orders in hand sufficient to carry them over a few months ahead. Tyre, axle, and spring manufacturers, on the other hand, which are unaffected by the new American Tariffs, are only partly employed, while crucible steel makers are still awaiting orders for their products. Some substantial quantities of tool and spring steel are also on order for the Australian and South African markets, but otherwise business remains in a stagnant condition. A rapid return of confidence in the Scottish iron and steel trade is now promised, and this week big additions are being made to working staffs. Home consumers have been advised that Belgian works are fully booked up, which will keep them out of markets for three months; besides which, the Germans notify that shipment is impossible under twelve weeks. Accordingly, as home makers believe that before the Belgians and Germans again come on the market our home prices will be more approximate to Continental quotations, preparations are being pushed forward to reopen works with the view to preserving the overseas markets. Substantial orders have already been placed

Scrap.

In all districts the condition of the scrap market remains unchanged, demand continuing slow and dealings on a limited scale. The steel manufacturers are able to cover their requirements by buying any small lots offered at low figures; no deals of importance have been reported.

Tinplates.

The outlook in the tinplate market at present can hardly be described as encouraging, and the few export orders coming to hand being quite insufficient to keep the works now running fully employed, and in consequence a fair number of plates are going into stock. Price movements in the market are without special features of interest, business having been reported done at 23s. basis for coke tinplates, net cash, f.o.t. at works for September, but for October and onwards there are sellers at 21s. basis. Tinplate bars stand officially at £8 10s. per ton, which, is roughly. £2 per ton over the figure at which Continental bars can be bought. Wasters continue in moderate request Current quotations range as follows:—CW, 28 x 20, 39s. per box; CW, 14 x 20, 19s. 6d. per box; CW, 14 x 18¾, 16s. to 16s. 3d. per box; CW, 20 x 10, 22s. 3d. to 22s. 6d. per box; all net, f.o.t. Wales. Terneplates continue easy and in poor demand at round 22s. basis for usual specifications, net cash, October delivery.

Metals.

Copper.—Messrs. Henry Bath & Son, Limited, in their fortnightly metal report under date September 2, 1921, write:—The decline referred to in our last report made rapid progress during the early part of this last fortnight until the 23rd ultimo, when £65 15s. was accepted for three months. At this point the market steadied under good buying, and later improved rather sharply. A little better trade has been done with consumers in this country, prompt delivery being generally required pointing to a bareness of stock, the replacement of which is not yet being indulged in by the majority. America has shown a little more firmness and reports more business for both home and export, especially the latter, Germany being a good buyer. According to latest reports, production is likely to suffer a still further contraction unless more orders come along and prices improve. Closing prices:—Cash, Wednesday, £67 15s.; Thursday, £67 15s.; Friday, £68 12s. 6d.; Monday, £68 17s. 6d.; Tuesday, £68 12s. 6d. Three Months: Wednesday, £68 12s. 6d.; Thursday, £68 12s. 6d.; Friday, £69 10s.; Monday, £69 15s.; Tuesday, £69 17s. 6d.

Tin.—This market has continued to decline during the past fortnight, with heavy trading and spasmodic slight recoveries, until £148 10s. and £150 10s. were accepted for cash and forward respectively on the 25th ultimo. This level attracted buyers of forward and induced bears to cover freely, so that prices recovered by the 30th ultimo to £157 10s. and £159. Since then on the 1st instant a reaction carried prices nearly £3 down, the whole loss, however, being recovered to-day on better American advices and the publication of some August statistics showing a reduction in the visible supply of between 500 and 800 tons. The August arrivals in America are given at 2,560 tons and the deliveries as 3,320 tons. The East has been selling fairly freely at advancing prices. America reports better trade and was at one time buying on a fairly large scale. The agreement between the Federated Malay States and the Dutch Government to hold their stocks off the market until the end of August last, has been renewed for an indefinite period. Closing prices:—Cash: Wednesday, £157; Thursday, £154 10s.; Friday, £156 15s.; Monday, £159 5s.; Tuesday, £161 5s. Three Months: Wednesday, £159 5s.; Thursday, £156 12s. 6d.; Friday, £159; Monday, £161 15s.; Tuesday, £163 15s.

Spelter.—After an easier tendency and slightly lower prices a small recovery followed on a better demand from consumers. German spelter is more firmly held owing to the good demand on the Continent and to the relatively better prices obtainable there. Closing prices:—Wednesday, £25; Thursday, £24 17s. 6d.; Friday, £24 7s. 6d.; Monday, £24 15s.; Tuesday, £24 15s.

Lead.—Fluctuations have been small, but the near position has been firmer than the distant. The tone has been fairly good throughout with a better demand from consumers during the last few days. Supplies are still somewhat restricted, but America is reported to be selling to the Continent in competition with this country. Closing prices:—Wednesday, £24 5s.; Thursday, £24 10s.; Friday, £24 10s.; Monday, £24 5s.; Tuesday, £23 15s.

"Coal Economy is in the Air"

On the one hand
Natural Draught with costly brick chimney emitting black smoke that spells waste and the draught at the mercy of the atmospheric conditions.

Send for Catalogue No. 1009.

On the other hand
SIROCCO
Induced Draft with inexpensive steel stack and no wasteful smoke because the Fan ensures perfect combustion and correct draught at all times.

DAVIDSON & Co LTD.
SIROCCO WORKS,
BELFAST.
TRADE
SIROCCO
MARK

Gazette.

MR. W. J. D. PARSONS, Guildhall Buildings, Navigation Street, Birmingham, and 23, Dale Street, Leamington, mechanical engineer and machinery merchant, has been adjudicated bankrupt.

A RECEIVING ORDER has been made in connection with the affairs of Mr. T. C. Richards and Mr. W. C. Richards, carrying on business at Castle Buildings, Llanelly, as C. T. Richards & Son, metal merchants.

TAFF SHIPBUILDING ENGINEERING AND DRY DOCK COMPANY, LIMITED.—It was resolved July 15, confirmed August 10:—That the company be wound up voluntarily. Mr. W. Rutter, 2, Stuart Street, Cardiff, has been appointed liquidator.

MESSRS. T. C. RICHARDS AND W. C. RICHARDS, St. Peter's Terrace, trading as C. T. Richards & Son, Castle Buildings, all Llanelly, metal merchants, have been adjudicated bankrupts. Examination, Guildhall, Carmarthen, October 11 at 12.

THE PARTNERSHIP between Messrs. J. Lowson and G. Austin, trading in the style of W. C. Martin & Company, 10, West Campbell Street, Glasgow, with branches at Dundee, Kirkcaldy, and Grangemouth, electrical engineers, has been dissolved. Debts by Mr. J. Lowson, who continues the business.

THE PARTNERSHIP formerly carried on as Jamieson Bros. by Messrs. J. Jamieson and J. G. Jamieson, Alloa, engineers, has been dissolved. The business will in the future be carried on under the same name by Mr. J. G. Jamieson for his own behoof, and all accounts due to or by the firm will be settled by him.

Deaths.

MR. T. DAVID, of 43, Albany Terrace, Dundee, died on August 27. The deceased was the secretary of the Ward Foundry, Dundee.

THE death took place at the American Hospital at Neuilly, near Paris, on July 25, of Mr. Peter Cooper Hewitt, the famous American scientist and inventor.

MR. T. DAVID, of 43, Albany Terrace, Dundee, died on August 27. The deceased was the secretary of the Ward Foundry, Dundee.

MR. Z. WEBB ONIONS, general manager of the Wolverhampton Steel and Iron Company, Limited, died recently at White Lodge, Church Road, Edgbaston. Mr. Onions was for a long time a member of the Iron and Steel Institute and the Birmingham Exchange, where he was very highly respected.

MR. J. H. DEWHURST, head of the firm of Dewhurst's Engineering Company, Limited, Sheffield, who died at his residence, "Beechy Knowle," Richmond, Sheffield, on August 22, was born in Manchester in 1854, and was educated at Milk Street School, Sheffield. Later he received engineering training at various firms in Manchester and Sheffield, and was subsequently employed by six or seven firms, including the Workington Company, where he was chief engineer from 1886-89; and later occupied a similar position with the Frodingham Iron and Steel Company between 1889 and 1891. In the latter year he joined his father's firm, John Dewhurst & Son, and in 1902, when the firm was converted into a limited company, he was elected managing director and chairman. He was a prominent figure in local Masonic circles, and was also a member of the Iron and Steel Institute and the Institute of Mechanical Engineers.

MISCELLANEOUS advts., see also page 18.

ORDERS wanted for Wood Moulders, Snap Boxes, Stump and Machine, Oddside Frames, Trays, ½-side Frames, Press and Stump Boards Rim Patterns, etc.: quick delivery.—Send your requirements to JOHN J. BUCK, Foundry Requisite Manufacturer, 30, Temple Road, Willenhall, Staffs.

ERITH LOAM (Strong).—Large or small quantities by rail; immediate despatch.—BUCKLEY, Sand Pits, Erith.

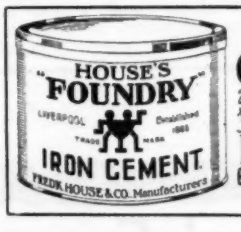
ENQUIRIES SOLICITED FOR CASTINGS IN IRON, machined or unmachined, up to fifteen cwt. Complete machines built throughout to specification, singly or in quantity. Jig and Tool Work a speciality.—C. S. PEATFIELD, LIMITED, Market Rasen.

FOR SALE, cheap, 100 tons of Foundry Pig-iron, planished, and C.R. C.A. Sheets, Joists, Channels, Angles, Tees, Plates, all thicknesses, Plumbago.—ASCOG, 10, Goldsmith Place, Kilburn, N.W.6. Telephone: Hampstead 8532.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—JAMES G. CROWTHER, Paradise Street Brass Foundry, Sheffield.

WE Specialise in Aluminium Castings, die and sand. Enquiries solicited. Prompt deliveries. Also Castings in Brass, Gunmetal and Phosphor or Manganese Bronze.—H. PERKS & COMPANY, The Foundry, Stanley Road, South Harrow.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited. Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with VIDEX PATTERN WORKS AND FOUNDRY, Huntsworth Mews, Upper Baker Street, London, N.W.1. (Telephone, Paddington 364).



IRON CEMENT
2lb. 5lb. 7lb. 10lb. TINS
¼ cwt. 1 cwt. CASKS
F^K. HOUSE & C^o
68 FALKNER ST.
LIVERPOOL.

FOUNDRY REQUISITES.
Try our REFRACTORIES.
Ganister or Silica Bricks and Blocks (any shape or size).
Sands, Cements, Ganister.—*Let us have your enquiries.*
THE CLEVELAND MAGNESITE & REFRACTORY CO., LTD.,
Normanby Brickworks Normanby, Eston Yorks.

HARRIS BROS.
(Late PETER HARRIS).
Metal Brokers, Mineral Agents, and Carriers.
BRIERLEY HILL, STAFFORDSHIRE.

SUPERIOR SILICA BRICKS
FINE SILICA CEMENT.
TRADE MARK— R. DINAS.
H. & H. E. SMART KIDWELLY.

LIMESTONE for FLUXING
98% Calcium Carbonate
Ideal for Metallurgical purposes. Can commence deliveries immediately.
LARGE CONTRACTS ARRANGED.
LECKHAMPTON QUARRIES CO., LD.
CHELTENHAM, GLOS.

THE INVINCIBLE SAND MIXER.

Fitted with Patent Roller Bearings, Renewable Reels, Grinds Mixes, Screens & Prepares.
OLD AND NEW FOUNDRY SANDS AT LOWEST COST.
Saves Labour—Reduces Foundry Costs.
Made in Three Sizes—1 3 and 6 Tons per hour capacity.
24" *Mixer—3 Ton per Hour.*
USED IN PRINCIPAL FOUNDRIES.
PRICES ON APPLICATION.
C. E. V. HALL, 26, Paradise Sq., Sheffield.